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Veterinary Roentgenology

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A discussion of X-ray equipment, its minimum requirements, and approximate cost.

Montgomery L. Houston, '41

THIS portion of the roentgenological discussion will be concerned with practical veterinary X-ray equipment and its elementary use. Since most of this is used in small animal practice, the discussion will concern itself mainly with that phase of the field.

The practitioner faces a number of problems upon deciding to install radiographic apparatus. Provision must be made for adequate fluoroscopic and roentgenographic equipment. The price he is able to pay determines the quality and quantity of this equipment. Installation of an X-ray machine and its accessories requires office and dark room space. The veterinarian then has the task of educating himself to use his new acquirements in an intelligent and profitable manner.

Equipment

The veterinarian desires a minimum amount of apparatus which will allow him to make fluoroscopic examinations of small animals and X-ray pictures of subjects ranging from small animals to the limbs of the horse. This equipment includes the X-ray machine, fluoroscopic screen, film, film holders, and a developing outfit.

In the purchase of the X-ray machine, the veterinarian has the choice of either new or used equipment in shockproof or the older bare conduit types. In any case, there are certain minimum practical requirements. The machine should be able to deliver a current of at least 10 MA (milliamperes) to the tube. A full adjustment of the MA range from zero to maximum is advantageous. The KV (kilovoltage) range is often unvariable in small machines, but it should be at least 30 KV to be of value. Another factor often encountered is the short allowable operating time on many machines due to rapid heating. A minimum of 15 seconds continuous operating time with not more than two minutes cooling period between operating periods should be the least acceptable when fluoroscopy is to be done. Stated breifly, the equipment should have an output of 30 KV at 10 MA for at least 15 seconds every two to three minutes. If the machine is of the bare conduit type, the tube should be supported in a leaded glass bowl to check the promiscuous dissemination of unwanted X-radiation.

A shockproof machine is simply one designed and constructed so that there is no danger of electrical shock to the patient or the operator in its use. This is accomplished by the use of adequate insulation over the transformer, controls, tube and cables. The machine now in use at the I.S.C. small animal clinic is of this type. A used shockproof machine costs twice as much as a used bare conduit type. Small used units cost from $150 up. For a good quality X-ray machine in this class, one must spend at least $300. New units range from about $300 up with a minimum of $550 for a first grade machine. In speaking of quality, there are numerous small X-ray equipment distributors. A number of these have concentrated on putting out compact attractive units of low power and low price. The lack of flexibility and power of these may easily put them in the

classification of office adornments. The large well known electrical manufacturers building X-ray equipment put out small portable units of guaranteed performance at a price that is several times that of the cheaper products. Any prices mentioned are only approximations of present market prices.

Shockproof Type

During the past decade, the bare conduit or non-shockproof X-ray machine has been almost entirely supplanted by the shockproof type. There are many of these used machines stored as trade-ins which would prove fairly practical for the veterinarian who cannot afford to spend more than a few hundred dollars, yet desires a capable instrument. In order to illustrate what is available in this line, the following is a description of one such machine. It is composed of a substantial pillar stand, six feet high, mounted on rollers with a holder for the transformer box and an adjustable tube support. The transformer is portable, measuring about two and one-half feet high, one foot deep and two feet wide. Milliamperage controls and milliameter are furnished. Three settings for kilovoltage are provided by changing contact posts on the high voltage side. Its range is from 0 to 20 MA at 15, 30, or 60 KV. The tube is of the glass Coolidge type mounted in a leaded glass bowl. Connections from the tube to transformer are made with small bare wires. The tube could be positioned under a table top for fluoroscopy or overhead for roentgenographic work. A machine of this type when used with much care, either as an office or portable unit, is sufficient for the average veterinary X-ray work. Its drawback is the everpresent danger of shock to a nervous patient and the operator.

As was explained in the previous article,* X-rays are invisible to the eye. Their presence may be rendered visible, practically, by means of either fluoroscopic screens or photographic film. The fluoroscope utilizes the property of various chemicals (calcium tungstate for example) to emit visible light when subjected to X-radiation. These chemicals are distributed evenly over a paper-like sheet, or in a thin transparent base material. In practice, a sheet of this material is put in a frame in order to protect it from damage. A leaded glass is interposed on the viewing side in order to transmit visible light and shield the user from X-radiation which penetrates the screen. The fluoroscopic screen is mounted either in a simple frame, which may be interposed between the viewer and the object for use in a well darkened room, or it is mounted in the end of a light-tight cone, the other end of which fits about the user's eyes, thus allowing fluoroscopy in illuminated surroundings. The first type has the distinct advantage of allowing the user freedom of movement of both arms and head whereas the second type, unless held in place by a headband, requires one hand to hold the screen. These screens are rather expensive. A new 8″x10″ screen costs from $40 up. Used screens may be purchased but it should be borne in mind that they deteriorate appreciably after several years of use, especially if they have not been properly stored in a dark, clean place.

Film

Photographic film of the type used in ordinary cameras is sensitive to X-radiation as well as to visible light. Special modifications have been developed in efforts to produce films which are very sensitive to X-rays and accurately reproduce the varying densities of the object being radiographed. Two types in general use are termed screened and unscreened films. Unscreened films simply record the actual passage of the X-rays through the film itself whereas the screened films are equally sensitive to the X-rays plus a high sensitivity to the wave length of visible light which is given off by fluorescent screens. In practice the unscreened type is held in a light-tight cardboard folder and the screened type is compressed in a special holder, termed a cassette, which holds a fluorescent screen firmly against

* Houston, M. L. 1940. Elementary discussion of Roentgenology. Vet. Student 3:19-22.

each side of the film. Since X-ray film has a sensitized gelatin coating on both sides of the base material, there is an image or radiograph registered which is the result of the X-rays passing through the film plus the visible light effect on each side. The use of screened film in an intensifying cassette therefore allows the exposure time to be reduced to approximately one-tenth that of the unscreened film. In practice where it may be economical to keep but one type on hand for all usage the screened film is satisfactory.

Film Sizes

X-ray film commonly comes in boxes of one dozen. Sizes most used are 5″x7″, 8″x10″, 10″x12″, and 14″x17″ with approximate costs per dozen films of $1.20, $2.65, $4.15, and $8.00 respectively.

Film storage requires a reasonably cool, dark place which will not be subjected to direct or scattered X-radiation. Special lead lined film storage boxes are available. These may be kept close to the X-ray machine without danger of film fogging.

Cardboard film holders mentioned previously are inexpensive and it pays to have several for each size of film used. The intensifying cassettes, however, are priced from about $15 (5″x7″) up, depending on size and quality. In veterinary roentgenography, immobilization of the patient is often the most difficult part of the proceedings and the rapid exposure permitted by the intensifying screens is invaluable.

The veterinarian finds it necessary to develop his own films. This presents no unusual difficulties. Equipment may range from three enamelware pans of sufficient size to hold the films to elaborate partitioned tanks with special noncorrosive film holders. The chemicals for developing and fixing the films are supplied in bulk packages and only require mixing with water. These may be kept in stock solution bottles and used as required. The large photographic supply companies offer free bulletins and instructions on this procedure.

The matter of a darkroom, or its equivalent, must be fitted to each case. A light-tight room is needed with sufficient space for shelves on which to place the developing trays or tanks, to store the solutions, and to load the film holders. Running water is convenient but not essential. Normal electrical illumination and a proper red safelight should be provided. Most operations, however, should and can be carried on in total darkness. A darkroom convenience which should not be overlooked is a timing clock which is pre-set to the interval the film is to remain in a solution. A bell rings at the expiration of this time.

The importance of roentgenography in human medicine has led to the development of an enormous number of accessories to the X-ray machine. Filters, diaphragms, special cones, and a host of other things are available to the veterinarian who has the time and knowledge required for their use. The essential apparatus has been covered in the preceding paragraphs. Should a veterinarian desire to know what might be the least equipment he could get along with at the initial installation the following list is suggested:

1. X-ray machine.
2. Adjustable standard for tube.
3. Silent split second timer.
4. Examination table for fluoroscopy or radiography.
5. Fluoroscopic screen, minimum of 5″x7″.
6. Film holders (cardboard holders, one 5″x7″, one 8″x10″ or intensifying cassette, preferably 8″x10″.)
7. Film, one dozen of each 5″x7″ and 8″x10″, screened type.
8. Darkroom equipment (three non-corrosive trays or tanks, safelight, timing clock, chemicals—developer and fixer.)

Total cost of first grade new equipment (portable, shockproof machine) is about $675.

(Editor's note: In the fall issue 1941, the author will conclude his series of articles on Roentgenology with a discussion on the use of X-ray equipment.)